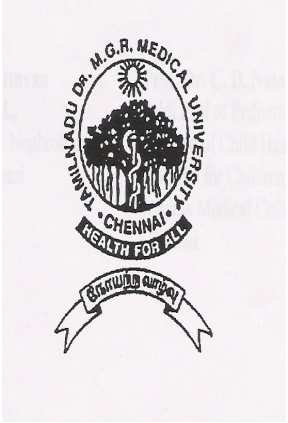
PREVALANCE OF CARDIAC DISORDERS IN ASYMPTOMATIC SCHOOL CHILDREN BETWEEN 5 TO 15 YEARS OF AGE

Dissertation Submitted for

M.D. DEGREE EXAMINATION

BRANCH VII – PAEDIATRIC MEDICINE



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MARCH – 2008

CERTIFICATE

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SPECIAL ACKNOWLEDGEMENT

My sincere thanks to **Prof. Dr. T.P. KALANITI M.D.,** the Dean, Madras Medical College and Research Institute for allowing me to do this dissertation and utilize the institutional facilities.

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to **Prof. Dr. SARADHASURESH, M.D., PhD., FRCP.,** Professor of Paediatrics, Director and Superintendent (I/C) of Institute of Child Health and Hospital for Children for permitting me to undertake this study.

I am extremely thankful to **Prof. Dr. E. SATHYA LATHA, M.D., D.C.H.,** Professor of Pediatrics and our unit chief for her guidance, invaluable help, encouragement and support throughout the study.

I would like to thank my unit Assistant Professors of Paediatrics, **Dr.R. SOMASEKAR, M.D., D.C.H., Dr. KUMARESAN, DCH.,DNB. Dr. N. RATHINAVELU, M.D.,** and **Dr. S. BALA MEENA M.D., D.C.H., D.M.** for their valuable guidance and assistance in doing this work.

I would like to thank **Dr. K. NEDUNCHELIAN M.D., D.C.H.,** for his valuable suggestion and guidance in doing this study.

I express my sincere thanks to **Dr. GNANASAMBANDAM M.D., D.C.H., D.M. (Cardio).,** and **Dr. THIRUVASAKAM, M.D.,DCH** for their valuable suggestion and guidance in doing this work.

I extend my sincere thanks to **Dr. P. RAMACHANDRAN, M.D., D.C.H.,** Registrar for his valuable suggestion and guidance in doing this work.

I sincerely thank all the children and their parents who had submitted themselves for this study without whom this study would not have been possible.

CONTENTS

INTRODUCTION

The prevalence of congenital heart disease in children is 0.5 to 0.8%. The prevalence of rheumatic heart disease is varying from 5 to 10 per 1000 children (excluding mitral valve prolapse, and bicuspid aortic valve). These diseases usually have cardiac murmur. Some of them go undetected in the early part of life and they present with major cardiac problem in the later part of life.

Heart murmurs are the most common cause of referral to the Cardiologist. Most of them are innocent murmurs. However thorough physical examination and ancillary procedures can uncover underlying severe cardiac malformations.

So it is necessary to know the actual prevalence of cardiac disorders in children who present with heart murmur as the only manifestations and the diagnostic value of echocardiogram in evaluation of these murmurs.

Heart Murmurs:

Murmurs are due to turbulence in the blood flow at or near valve or an abnormal communication within the heart. It follows that a loud murmur may originate from a small orifice such as a ventricular septal defect. Equally a soft murmur may originate from a large abnormal orifice as in very severe aortic regurgitation. Thus , while it is important to note the intensity of a murmur, one should not make deductions about its importance from its loudness.

Not all murmurs are produced by a structural disorder of the heart, they may be due to abnormally rapid flow of blood through a normal valve. Such murmurs are called flow murmurs and it should be remembered that they do not indicate a valvular disease.

Flow murmurs have the following characteristics

- They are always part of an ejection pattern
- They may have either a grunting or a musical component
- Their timing is generally earlier in systole than murmurs due to an organic obstruction to outflow
- They may arise from either the left or right ventricular outflow tracts
- They are never associated with any abnormality of the thoracic wall , such as a depressed sternum.
- Their intensity may be increased by physiological manoeuvres that increase the cardiac output

Flow murmurs are most commonly encountered in children and young adults or in the elderly . They also occur whenever there is an increased stroke volume such as anemia , thyrotoxicosis , hypertension , or in chronic anxiety. In pregnancy a flow murmur in the pulmonary area is an invariable finding and does not indicate the presence of a cardiac abnormality.

Murmurs may be systolic, diastolic or continuous throughout systole and diastole,

and can only be a timed reliably if the carotid arterial pulse is palpated during auscultation so that systole can be determined .

Systolic murmurs are either pansystolic, as in mitral or tricuspid regurgitation and ventricular septal defects, or ejection, when they arise either from the pulmonary or aortic outflow tracts. Pansystolic murmurs are start immediately with the first heart sound and continue through to the second heart sound. Typically they have uniform intensity. By contrast, ejection systolic murmurs have an diamond shaped configuration building to a peak in mid systole. Ejection murmurs typically diminish before the second heart sound.

Late systolic murmurs are due to mitral valve prolapse, mild ischaemic mitral regurgitation or hypertrophic cardiomyopathy with obstruction . Clinically they are characterized by a clear gap between the first heart sound, which is often loud, and the onset of a murmur in mid or late systole. The murmur then continues right up to and through the aortic component (A2) of the second heart sound.

Diastolic murmurs are of two types : early diastolic murmurs start at the second heart sound and occur as a result of aortic or pulmonary regurgitation , while mid diastolic murmurs, in which there is a short gap after the second heart sound before the beginning of the murmur , arise from the mitral or tricuspid valve.

Importance of Murmurs

A large number of children (including neonates) are detected to have a cardiac murmur; especially prior to school age[1]. Some murmurs in neonates, many in infants and most in childhood are 'benign' or 'innocent'[1-5]. However, a cardiac murmur may be the first sign of a serious structural cardiac disease, especially in the neonate[6]. The latter not only carries a high morbidity (and if untreated, mortality) but also have enormous financial and psychological implications for the child and parents.Hence differentiation of one from the other is mandatory.

Causes and symptoms of heart murmurs:

Innocent heart murmurs are caused by blood flowing through the chambers and valves of the heart or the blood vessels near the heart. Sometimes anxiety, stress, fever, anemia, overactive thyroid, and pregnancy will cause innocent murmurs. Pathologic heart murmurs, however, are caused by structural abnormalities of the heart. These include defective heart valves or holes in the walls of the heart. Valve problems are more common. Valves that do not open completely cause blood to flow through a smaller opening than normal, while those that do not close properly may cause blood to go back through the valve. A hole in the wall between the left and right sides of the heart, called a septal defect, can cause heart murmurs. Some septal defects close on their own; others require surgery to prevent progressive damage to the heart.

The symptoms of heart murmurs differ depending on the cause of the heart murmur. Innocent heart murmurs and those which do not impair the function of the heart have no symptoms. Murmurs that are due to severe abnormalities of a heart valve may cause shortness of breath, dizziness, chest pains, palpitations, and lung congestion.

Innocent murmurs

Those murmurs that occur in the absence of structural cardiac disease are said to be 'innocent'. They have been variously described as functional, benign, innocuous or physiologic murmurs.

Innocent murmurs of childhood:

- Systolic murmurs
- Vibratory Still's murmurs
- Pulmonary flow murmur
- Peripheral pulmonary arterial stenosis murmur
- Supraclavicular or brachiocephalic systolic murmur
- Aortic systolic murmur
- Continuous murmurs
- Venous hum
- Mammary arterial soufflé

The Vibratory Still's murmur:

This is the most common innocent murmur in children. First described by George

F. Still in 1909[7], it presents most often between the age of 2 and 6 years, though it may be present at extremes of age (adolescence and infancy). It is an early systolic grade 1 to 3 (usually grade 2), low to medium pitched murmur, best heard at the lower left sternal edge and extending to the apex and loudest in the supine position. It changes on sitting or standing. It has a distinctive vibratory quality or a twanging sound, which gives it a musical character.

The origin of the murmur is not clear. This has been attributed to various causes including vibration of the pulmonary valves during systolic ejection, physiologic narrowing of the left ventricular outflow tract[8] and presence of ventricular false tendons[9].

The Pulmonary flow murmur

This may be heard in children, adolescents and young adults. It is an ejection systolic murmur, crescendo-decrescendo in character, of low intensity (grade 2-3) and is heard at the left sternal border in the 2nd and 3rd intercostal spaces. It is rough in character and is thus distinct from the musical Still's murmur. Best heard in the supine position, it is also exaggerated by a pectus excavatum, a straight- back or kyphoscoliosis that results in compression or brings the right ventricular outflow tract closer to the chest wall. The murmur increases in intensity in expiration while inspiration and upright position decrease it.

The innocent pulmonary flow murmur should be distinguished from murmurs due to increased flow in an atrial septal defect and also from pulmonary valvular stenosis.

The presence of a hyperdynamic right ventricular impulse; wide, fixed splitting of the S2 and a mid-diastolic flow murmur help in the distinction of the former, while in the latter, the presence of a systolic thrill, a longer and more harsh murmur and ejection click would aid in the diagnosis.

Peripheral pulmonary arterial stenosis murmur

This is commonly heard in infants and neonates. It is of ejection systolic character, grade 1 to 2 low pitched and extends till or just beyond S2. These murmurs become more prominent with viral upper respiratory tract infections, especially in the recovery phase, and reactive airway disease. They are often best heard in the axilla or on the back.

Common innocent heart murmurs

Type (Timing)	**Description of murmur**	**Age group**
Classic vibratory murmur (Still's murmur) (systolic)	Maximal at mid-left sternal border or between lower left sternal border and apex. Grade 2 to 3/6 Low frequency vibratory, "twanging string", groaning,	3-6 yr Occasionally in infancy

	squeaking, or musical	
Pulmonary ejection murmur (systolic)	Maximal at upper left sternal border Early to mid-systolic Grade 1 to 3/6 Blowing in quality	8-14 yr
Pulmonary flow murmur of newborn (systolic)	Maximal at upper left sternal border Transmits well to the left and right chest, axilla, and back Grade 1 to 2/6	Premature and full term newborns Usually disappears by 3-6 month of age
Venous hum (continuous)	Maximal at right or left supraclavicular and infraclavicular areas Grade 1 to 3/6 in intensity	3-6 yr
Carotid bruit (systolic)	right supraclavicular area and over the carotids Grade 2 to 3/6	Any age

Supraclavicular or brachiocephalic systolic murmur

This murmur, heard in children and young adults is a crescendo-decrescendo early systolic murmur best heard above the clavicles with radiation to the neck. It is low to medium pitched and brief. The murmur does not change with supine or sitting position but diminishes with hyperextension of the shoulders[10]. This murmur is thought to originate from the brachiocephalic vessels as they arise from the aorta.

Aortic systolic murmur

This murmur is an innocent systolic flow murmur arising from the left ventricular outflow tract and associated with increased systemic cardiac output. It is ejection in character, systolic and is best heard in the aortic area. Common situations in children where these murmurs are heard include fever, anemia, anxiety, hyperthyroidism, etc. Similar murmurs may be heard in trained athletes with slower heart rates and greater stroke volume.

The main differentiation is from hypertrophic obstructive cardiomyopathy (HOCM) and left ventricular outflow tract obstruction. In HOCM, increased venous return (as in rapid squatting) diminishes the murmur, while the valsalva maneuver causes it to be louder. Also, the presence of positive family history should alert the clinician in favour of HOCM.

Venous hum

This is the most common continuous murmur in children. Initially described by Potain in 1867[11], It is most audible in the neck, anteriorly, just lateral to the sternocleidomastoid muscle often extending to the infraclavicular region of the chest

wall. It is usually louder on the right side, better heard sitting than lying and is best elicited with the patient sitting up and looking away from the side of examination. It is widely variable in character and intensity, from faint to grade 6. Gentle compression over the jugular vein or turning the head towards the side of the murmur diminishes the murmur. Turbulence at the confluence of flow from the internal jugular and subclavian veins as they enter the superior vena cava, or angulation of the internal jugular vein as it courses over the transverse process of the atlas, is thought to cause this venous hum[12].

The Mammary artery souffle

This murmur, well recognized in late pregnancy and lactation, can rarely occur in adolescence. This starts in systole but may extend into diastole and is heard on the anterior chest wall over the breast. It is high pitched, has a superficial character and firm pressure with the stethoscope may sometimes abolish the murmur. Thought to be arterial in origin, it occurs due to the enlarged vessels of the chest wall.

Differentiation from a murmur due to patent ductus arteriosus or arterio-venous fistula is essential.

Carotid Bruit

This is an early systolic ejection murmur, best heard in the supraclavicular fossa or over the carotid arteries. It is produced by turbulence in the brachiocephalic or carotid arteries. The murmur is a grade 2 to 3/6 in intensity. Although it rarely occurs, a faint thrill is palpable over a carotid artery. This bruit may be found in children of any age.

The murmur of aortic stenosis often transmits well to the carotid arteries with a

palpable thrill, requiring differentiation from carotid bruits. In aortic stenosis, the murmur is louder at the upper right sternal border, and a systolic thrill is often present in the upper right sternal border and suprasternal notch, as well as over the carotid artery. An ejection click is often present in aortic valve stenosis. The ECG and chest X ray film may appear abnormal.

All innocent heart murmurs are associated with normal ECG and X-ray findings. When one or more of the following are present, the murmur is more likely pathologic and requires cardiac consultation:

1. Symptoms
2. Abnormal cardiac size or silhouette or abnormal pulmonary vascularity on chest roentgenograms
3. Abnormal ECG
4. Diastolic murmur
5. A systolic murmur that is loud (i.e., grade 3/6 or with a thrill), long in duration, and transmits well to other parts of the body
6. Cyanosis
7. Abnormally strong or weak pulses
8. Abnormal heart sounds.

Characteristics of pathologic murmur

These include,

- A systolic murmur with intensity of grade 3

- A diastolic murmur
- Maximal intensity of murmur at left upper sternal border.
- Harsh quality of a murmur
- Presence of an early/mid systolic click
- Presence of an abnormal S2.

Approach to a child with a murmur

History

The history should elicit the presence or absence of the cardinal cardiac symptoms. The symptoms of congestive heart failure in infants are very subtle and may be missed, if not specifically asked for. Past history of hypertrophic cardiomyopathy, congenital heart disease or unexplained childhood / early adulthood death is of importance. A perinatal history of premature birth, maternal diabetes, drug or toxin ingestion and intrauterine infection is relevant.

Examination

Apart from examination of the cardiovascular system, perhaps, the most important assessment is the evaluation for dysmorphism and the presence of other congenital anomalies. Presence of anomalies of other organ systems is associated with congenital heart disease in as many as 25% of cases. The assessment of the child's growth and development is vital and may inform us about "failure to thrive". The child's play capacity &/or ability to exercise should be sought for. A systematic cardiovascular examination including assessment of the arterial pulses and perfusion, measurement of blood pressure, the systemic venous assessment, precordial inspection, palpation and auscultation in the four different areas, are done. Step-by-step auscultation firstly for heart sounds and subsequently for murmurs, and for additional sounds, as also clicks are required. A crucial auscultatory assessment in children is to characterize the second heart sound and its components. Auscultation should also be carried out over the back,

the axillae and the neck. Variations of murmurs and heart sounds with position (supine, sitting, and standing) and various maneuvers (respiration, valsalva, exercise) further characterize the nature of this.

Common cardiac conditions presenting as murmur in asymptomatic children

- Ventricular septal defect-small
- Pulmonary valve stenosis-mild
- Aortic valve disease-mild
- Atrial septal defect-small
- Patent ductus arteriosus -small
- Mitral valve disease
- Coarctation of the aorta-mild
- Subaortic stenosis-mild
- Atrioventriclular septal defect
- Tetralogy of Fallot during initial period

ATRIAL SEPTAL DEFECT (ASD)

Children with ASD are usually asymptomatic. A soft systolic murmur in the parasternal area may be picked up on routine examination, where wide fixed split of second heart sound is usually diagnostic.

Common types of ASDs encountered are of the secundum type and approximately 10% have defects at junction of superior vene cava and right atrium called sinus venous

defects. Cardiac catheterization confirms the diagnosis and clarifies the location of defects. The shunt is large and operation is recommended when there is increased pulmonary flow and the QP/QS is > 1.5. If the echocardiogram confirms the diagnosis then cardiac catheterization can be avoided in such cases.

Surgery is indicated in symptomatic patients irrespective of age. In asymptomatic patients, the operation is deferred till the patient reaches 5 years of age. All ASDs are usually repaired on cardiopulmonary bypass. The right thoracotomy can be used in females to avoid ugly median scar and recently in ASDs have been repaired by direct suturing.

VENTRICULAR SEPTAL DEFECT (VSD)

Ventricular septal defect (VSD) is the most common congenital cardiac defect comprising 20-25% of all lesions. VSD can occur as an isolated defect or can be a part of a complex lesion. The various types of VSD depending on the sites are perimembranous VSD, muscular VSD, and finally outlet and inlet VSDs. VSDs can be small or large.

Spontaneous closure of VSD occurs in around 30% of small VSDs, especially muscular ones. Large defect rarely closes without surgery. Increased pulmonary blood flow may result in pulmonary hypertension by about 12 months of age but rarely becomes irreversible before 2 years of age.

Chest x-ray shows cardiomegaly and increased pulmonary blood flow depending upon the shunt. ECG is normal in small defects, left ventricular dilatation in moderate to

large defects. 2D echocardiogram is diagnostic and reveals the site, size, number of VSDS and other associated lesions. Pulmonary artery pressure and left ventricular function are also assessed. Cardiac catheterization is indicated in symptomatic patients or in those who have a large shunt and QP/QS is > 1.5

Indications for surgery

In children less than 5-6 years - Small VSD with normal pH pressure - surgery is deferred.

If in these children - VSDS do not close spontaneously by 8 years - elective surgery is indicated to prevent SBE also, and reversal of shunt.

Large VSD with large shunt and increased pulmonary pressure- pulmonary vascular resistance (PVR) is calculated. If PVR is less than 4 Units - surgery is indicated. If PVR is more than 4 units -then response to 100% O2 inhalation is tried. In response to this, if the P.A. pressure goes down - then surgery is indicated.

However, if the VSD is large with severe PAH and where the PVR is > 4 units and the PA pressure does not reduce in response to 100% O2 - then only heart lung transplantation can save these patients.

PATENT DUCTUS ARTERIOSUS (PDA)

PDA connects main PA to descending aorta 5-10 mm distal to the origin of left subclavian artery, and it closes spontaneously during 2-3 weeks of life. If it does not close spontaneously, then it has to be closed surgically or by a device.

On examination, there is a typical bounding peripheral pulse and the typical

systolo-diastolic "machinery" murmur in the infra-clavicular area is heard. In the premature infants only systolic murmur is heard because of increased pulmonary vascular resistance.

Chest x-ray shows plethoric lung fields and enlarged left ventricle and ECG also documents left ventricular hypertrophy in presence of congestive cardiac failure. Echocardiography reveals LV volume overload with increased pulmonary artery flow and confirms the presence of pulmonary artery hypertension. Cardiac catheterization is only indicated if PDA is part of a complex lesion or if the diagnosis is in doubt. Closure of PDA can be brought about by

1) Intervention

The PDA is closed by an umbrella (Rashkinds') device which is put in the PDA by a catheter. However, recurrence rate is high and device is expensive and beyond reach of most of the poorer section of society.

2) Surgery

PDA can be closed by left thoracotomy by just ligating or dividing the ductus and suturing both the ends. Complicated PDAs (e.g.) hypertensive, calcified, infected or recanalysed ductus will need cardio-pulmonary bypass for repair.

MITRAL VALVE PROLAPSE

MVP is one of the common causes of asymptomatic heart murmur. Reported incidence of MVP of 5% in the pediatric population probably is an overestimate. This condition usually occurs in older children and adolescents (it is more common in adults)

and has a female preponderance (male-female ratio of 1:2). In MVP there is thick and redundant mitral valve leaflets bulge into the mitral annulus (caused by myxomatous degeneration of the valve leaflets and/or the chordae). The posterior leaflet is more commonly and more severely affected than the anterior leaflet.MVP is idiopathic in more than 50% of cases. A congenital heart defect is present in one third of patients with MVP. Secundum atrial septal defect is most common; ventricular septal defect and Ebstein's anomaly are found rarely. Of patients with MVP, 4% have Marfan's syndrome, and nearly all patients with Marfan's syndrome have MVP. MVP may be seen in association with other connective tissue disorders. MVP is familial in the primary form (with an autosomal dominant mode of inheritance).

MVP usually is asymptomatic, but a history of nonexertional chest pain, palpitation, and, rarely, syncope may be elicited. The patient occasionally has a family history of MVP.The midsystolic click with or without a late systolic murmur is the hallmark of this syndrome and is best audible at the apex The presence or absence of the click and murmur, as well as their timing, varies from one examination to the next.

A superiorly directed T vector (with flat or inverted T waves in II, III, and aVF) occurs in 20% to 60% of patients is seen in ECG. Arrhythmias are relatively uncommon and include supraventricular tachycardia, premature atrial contractions, and premature ventricular contractions. Conduction disturbances (first-degree atrioventricular block, Wolff-Parkinson-White syndrome or its variants, prolonged QT interval, or right bundle branch block) occasionally are reported. LVH or LAH rarely is present.

Echo findings for adult patients with MVP have been established, but those for pediatric patients are not clearly defined. M-mode echo shows posterior motion of the posterior and/or anterior leaflets of the mitral valve. Two-dimensional echo is more reliable and shows prolapse of the mitral valve leaflet(s) superior to the plane of the mitral valve. The superior displacement seen only on the apical four-chamber view is not diagnostic because more than 30% of pre selected normal children show this finding. The “saddle-shaped” mitral valve ring explains the superior displacement of the mitral valve seen in normal people in the apical four-chamber view. The mitral valve leaflets are thick, and MR occasionally is demonstrable by color flow mapping and Doppler examination. Many children with classic mid systolic clicks (usually without late systolic murmur) fail to show displacement of the mitral valve leaflets superior to the mitral valve plane in the parasternal long-axis view, although thickened leaflets and bowed leaflets within the LV cavity frequently are found. The absence of adult echo criteria for MVP in children may be explained by the fact that MVP is a progressive disease with an incomplete manifestation in children.

The majority of patients are asymptomatic, particularly during childhood. Complications that are reported in adult patients, although rare in childhood, include sudden death (probably from ventricular arrhythmias), SBE, spontaneous rupture of chordae tendineae, progressive MR, CHF, and arrhythmias and conduction disturbances.

MANAGEMENT

1. Asymptomatic patients require no treatment or restriction of activity.

2. Antibiotic prophylaxis against bacterial endocarditis is recommended when MR is present by auscultation or by echo studies.

3. Patients who are symptomatic (with palpitation, lightheadedness, dizziness, or syncope) or who have arrhythmias should undergo ambulatory ECG monitoring and/or treadmill exercise testing. Propranolol (or another ß-adrenergic blocker) is the drug of choice for ventricular arrhythmias. Other drugs, such as calcium blockers, quinidine, or procainamide, may prove to be effective in some patients.

4. Chest pain may be treated with propranolol. (It is not relieved by nitroglycerin, but may worsen.)

5. Reconstructive surgery or mitral valve replacement rarely may be indicated in patients with severe MVP.

DIAGNOSTIC OPTIONS:

For heart murmur, the laboratory testing considered is usually chest radiography, electrocardiography, or echocardiography.

Electrocardiogram:

It has limited sensitivity for the common forms of congenital heart disease in earlier stages that present with murmur[13]. Because many children with significant heart disease will have a normal ECG, it is hazardous to conclude from a normal ECG that a murmur is innocent. Some authorities point to advantages of the ECG as an integral part of the evaluation of murmur in children. Despite its low cost, the ECG is unlikely to be

of help distinguishing the pathologic murmur from the innocent one in the primary care outpatient setting.

Chest radiography:

Like the ECG, radiography findings in congenial heart disease have poor sensitivity, with many of the classic radiographic features appearing late in the clinical course[14]. False-positive cardiomegaly is relatively common in young children due to a large thymus or poor inspiratory effort, and this further degrades the value of test. Although some support the use of chest radiograph as a routine component of the Pediatric cardiologist's evaluation of heart murmur.

Echocardiography:

It is an exquisitely accurate means for diagnosis of congenital heart disease when technologists trained and practiced in the pediatric examination perform the test using equipment suitable for children and when the test is interpreted by pediatric echocardiographers[15].

Risks for adverse outcomes in children with a heart murmur and management:

Common shunt lesions:

Ventricular septal defect, atrial septal defect, and patent ductus arteriosus are associated with well-defined risks for adverse outcome, including chronic respiratory symptoms and failure to thrive attributable to pulmonary overcirculation. Some patients are also at risk for bacterial endocarditis.

Natural history and risks with common shunt lesions:

Defect	**Symptoms or Impairment**	**Potential for spontaneous improvement or resolution**	**Endocarditis risk**
VSD, small and moderate	Generally none	May close spontaneously	Yes
ASD	Usually none in small ASD	Spontaneous closure of secundum ASD is possible, but uncommon especially after age 2 years	No
PDA	Usually none with small PDA	Spontaneous closure after 6 months of age would not be expected	Yes

Common valvular and obstructive lesions:

A well-known set of risks also is associated with the commonly encountered valvular and obstructive lesions such as pulmonary stenosis, aortic stenosis, and

coarctation of the aorta. Discovery of such lesion is important because, even if mild, they represent indications for prophylaxis against bacterial endocarditis[15]. Mitral valve prolapse disappears in a significant proportion of patients over a period of years.

Natural history and risks with common valvular and obstructive lesions:

Defect	**Symptoms or Impairment**	**Potential for spontaneous improvement or resolution**	**Endocarditis risk**
Pulmonary stenosis (mild to moderate)	Generally none	None	Yes
Aortic stenosis or subaortic stenosis (mild to moderate)	Generally none	None	Yes
Coarctation of the aorta	Generally none if obstruction is not severe	None	Yes
Mitral valve prolapse	Many are asymptomatic	Yes	Yes, if associated mitral regurgitation is present

Management:

Because all of the common left-to-right shunt lesions (eg, VSD, ASD, PDA) except for isolated secundum type ASD are believed to carry risk for bacterial endocarditis[16], the patient and family should be educated regarding use of antibiotics for dental and surgical procedures when any of these conditions is diagnosed. Definitive management generally is surgical or transcatheter obliteration of the shunt. Patients with small defects in the muscular ventricular septum, mitral valve prolapse, for example, are far better served by observation, reassurance and antimicrobial prophylaxis against bacterial endocarditis during times of risk.

REVIEW OF LITERATURE

Rana Olgunturk, et al[17] studied the prevalence of innocent murmurs and congenital heart disease among school children in Ankara Turkey, The study was carried out in 34 schools from different regions and 4086 students between the ages 6 and 17 were examined. A secondary screening procedure was also carried out in all children who have murmurs and they were reexamined in pediatric cardiology unit. Innocent heart murmurs were detected in 9.3% of children, congenital heart diseases in 0.29% (majority being VSD 0.09%) and rheumatic heart disease in 0.073%.

K. Y. Chan and U. Rajan, et al[18] studied the types of cardiac diseases and dysrhythmias in a healthy population of 651794 school children who underwent general health screening between January 1981 to December 1986 in Malaysia. Congenital heart lesions were diagnosed in 1159 (0.18%) the majority being mitral valve prolapse (0.08%), small ventricular septal defect (VSD, 0.04%), mild PS (0.03%) and small Atrial septal defects (ASD, 0.02%). Other lesions detected were patent ductus arteriosus (PDA), coarctation of aorta (CoA), Fallot's Tetralogy (FT) and total anomalous pulmonary venous drainage (TAPVD). Cardiac dysrhythmias were seen in 350 patients. The cardiac screening programme has resulted in a significant detection of cardiac abnormalities among apparently healthy school children. Early detection of cardiac disease has resulted in early remedial measures to be taken and thus improved cardiological care.

Denizmen Aygun, et al[26] studied the prevalence and etiology of heart murmurs in

1000 school children selected from six primary school in Elazig. Different heart murmurs were detected in 28 (2.8%) of children. All children who had heart murmurs were evaluated. 10 (1.0%) cases of congenital heart disease were detected, but no rheumatic heart disease was detected. The heart murmur was due to anemia in one case and seventeen cases had innocent murmurs. Congenital heart lesions were detected in 10 cases (1.0%) the majority being small ventricular septal defect (0.08%) this study conclude that screening heart murmurs on asymptomatic school children to discover congenital heart disease is necessary.

Manes MT, et al[19] studied the diagnostic value of echocardiography in the differential diagnosis of functional pediatric murmurs. 260 children (132 males, 128 females, age range 1 to 8 years) were examined with auscultatory cardiac murmur. All children underwent a clinical and instrumental evaluation (ECG and ECHO) from two pediatric cardiologists with independent assessment. 210 patients (Group A) were evaluated clinically with functional murmur, 45 patients (Group B) with pathological murmur, 5 patients (Group C) with uncertain pathology. ECG showed changes in 1 group B patient. Echo showed pathology in 15 group A patients. Pathology was excluded in 3 Group B patients, and in 2 group C patients. Echo showed sensitivity 75%, specificity 97%, positive predictive value 90%, and negative predictive value 92%. This study suggests performing echocardiographic examination in children with functional murmur for complete assessment.

Birkeback, et al[20] studied the diagnostic value of the chest radiograph and ECG

in the evaluation of whether asymptomatic children with a cardiac murmur had a heart disease as defined by echocardiography. One hundred children aged 1 month to 15 years were included. After physical examination, a tentative diagnosis was made: 53 children had no heart disease, 24 had a probable heart disease and 23 children were thought to have heart disease on the basis of clinical assessment alone. After information from chest radiography and ECG was obtained, the diagnoses were re-evaluated. This resulted in a change of the tentative diagnosis in three children. However, the diagnosis in relation to the definite diagnosis by colour Doppler echocardiography was not changed to the correct diagnosis in any of these cases. In 24 cases, radiography suggested the presence of heart disease; however, only 10 of these had heart abnormalities on the Colour Doppler echocardiogram (CDE). Three children an abnormal ECG; all of these had abnormalities on the CDE, but they were already diagnosed as having heart disease by physical examination. This study concludes that chest radiography and electrocardiography is of no help in the discrimination between heart disease and no heart disease in asymptomatic children referred for a cardiac murmur.

Amaral FT, et al[27] studied the benefits of noninvasive tests in the characterization of heart disease in children with heart murmur. 233 children were fully examined with the aid of the electrocardiogram (ECG), chest X ray, Echocardiogram (ECHO). The patients were divided in 2 groups according to the initial diagnosis of innocent murmur (n=23) and pathological murmur (n=210). A comparison was made between the initial and final diagnosis after the noninvasive tests. Statistical analysis was

employed through the chi-square test. The initial diagnosis did not change after ECG and chest X ray. After ECHO, the initial diagnosis of innocent murmur was maintained in 70% of the cases, while 30% had some form of heart disease. In 80% of the pathologic murmur group, the diagnosis did not change after ECHO, while 20% were considered as having an innocent murmur. This study concluded that the careful clinical examination is mandatory in the initial evaluation of heart murmur. ECG and chest X ray does not change the initial clinical diagnosis and ECHO should be reserved to cases with obvious or persistent suspicious heart disease after clinical examination.

STUDY JUSTIFICATION

Heart murmurs are the most common cause of referral to the Cardiologist. Most of them are innocent murmurs. However thorough physical examination and ancillary procedures can uncover underlying severe cardiac malformations. So it is necessary to know the actual prevalence of cardiac disorders in children who present with heart murmurs as the only manifestation. It is essential to diagnose the associated heart disease with innocent murmur by doing various diagnostic modalities. The diagnostic ability of ECG, X ray chest and Echocardiogram to identify the heart disease also very important.

So this study might be very useful to know the actual prevalence of heart disease in asymptomatic school children with cardiac murmur.

AIM OF THE STUDY

1. To study the prevalence of cardiac disorders in the school children between 5-15 years of age group with asymptomatic heart murmur.
2. To make an early diagnosis of heart disease in children with asymptomatic heart murmur.
3. To analyze the diagnostic value of echocardiogram in evaluation of heart murmurs in asymptomatic children.

SUBJECTS AND METHODS

STUDY DESIGN : Descriptive study

STUDY PERIOD : November 2005 to May 2007

STUDY PLACE : Schools of Chennai city and
Institute of Child health and
Hospital for Children, Egmore.

STUDY POPULATION :

INBCUSION CRITERIA

Asymptomatic school going children between 5-15 years of age with a heart murmur were included in the study.

EXCLUSION CRITERIA

1. Children with known heart disease either congenital heart disease or rheumatic heart disease.
2. Children with symptoms suggestive of heart disease.
3. Children with anemia

Manoeuver:

Random selection of schools from all areas of Chennai city was done in such a way that the sample drawn represented children from various ages, both sexes, religious and socio cultural groups.

Four thousand six hundred (4600) school children of Chennai between the ages of 5-15 years were studied from November 2005 to May 2007. All children included were subjected to clinical examinations with particular emphasis on the cardiovascular system. Among 4600 school children 96 were found to have asymptomatic heart murmurs. Those children with heart murmur were advised to come with their parents to institute of child health and hospital for children, Egmore. They were followed up further.

These children were reexamined by a pediatric cardiologist in order to confirm the diagnosis of cardiac involvement. The final diagnosis was made on the basis of clinical, roentgenographic, electrocardiographic and echocardiographic findings.

1. **X ray chest**[14]

Both antero-posterior view and lateral view were taken in the erect posture and we looked for the following findings.

Cardiomegaly

Type of configuration of the apex

Features of left atrial enlargement –

Straightening of left border of cardiac silhouette

Shadow within shadow (in right cardiac border)

Lifting of left main bronchus

Feature of right ventricle enlargement

Obliteration of upper one third of retrosternal space

Feature of right atrial enlargement

Extension of right cardiac border more than one finger breadth from the right vertebral margin

Feature of pulmonary venous hypertension

Increased pulmonary vascularity

Kerley B line

Pulmonary edema

Features of pulmonary arterial hypertension

Prominent main, right, left pulmonary artery

Peripheral pruning of vessels

2. **Electrocardiogram**[13]

The twelve lead electrocardiogram was taken using "NIHON KOHDEN" computerized ECG in quiet environment at a paper speed of 25mm/sec. and a voltage standardization as the average of 10mm/mv. Amplitude measurement was calculated manually as the average of 2-3 consecutive heart beats.

Rate → Newborn : 110- 150 beats / min

2 Yrs : 85 – 125 beats / min

4 Yrs : 75 – 115 beats / min

>6 Yrs : 60 – 100 beats / min

P-R interval → 0.12 – 0.2 Sec. (normal)

QRS Axis → 0 - 90° (normal)

Left ventricular hypertrophy

- ST segment depression and inversion of the T wave in V5, V6
- Deep Q wave in the left precordial leads.
- Increased voltage of the S wave in V3R and V1 (>25mm) and the R wave in V5, V6 (>25mm).

Right ventricular hypertrophy

- qR pattern in V1, V2.
- A positive T wave in V1 , V2 from age 3 days to 6 yrs of life
- Monophasic R wave in V1
- rsR' pattern in the right precordial leads
- Right axis deviation
- Age corrected increased voltage of the R wave in V1, V2 and / or of the S wave in V6.

Left atrial enlargement

- Bifid P wave or increased P wave duration of >0.11 sec. in

L II.

- Biphasic P wave with the depth of >1 mm and duration of > 1 small square of negative complex in V1.

Right atrial enlargement

- Tall, narrow, spiked P wave >2.5mm in L II, and more than 1.5 mm in V1.

Cardiac arrhythmias – heart block , atrial fibrillation , atrial flutter , atrial and ventricular premature complexes.

3. **Echocardiographic examination**[15]

Each patient underwent a M-mode, two dimensional pulsed wave, continuous wave , colour Doppler study. Images were obtained on a Philips ENVISOR Ultrasound system with S4-2 (adult) and S8 (Pediatric) transducer. The children were studied in either supine or in left lateral position and looked for

- Presence of septal defects and ductus
- Vascular morphology and functions
- Left and right ventricular dimensions and functions
- Pulmonary pressures
- Vegetations
- Pericardial effusion

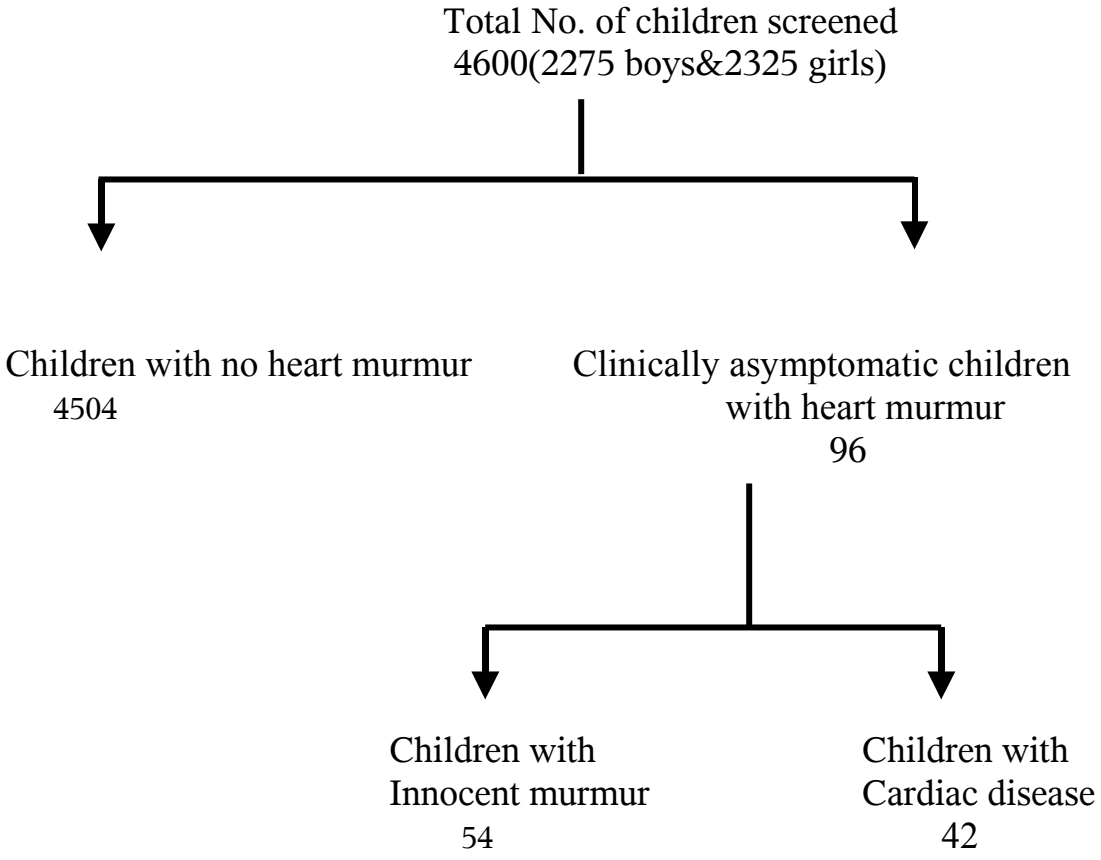
STATISTICAL ANALYSIS

Proportions of asymptomatic children with cardiac disorders and other

outcome measures were arrived at using Chi square test while comparing variables among study groups. P value <0.05 was considered for statistical significance.

OBSERVATIONS

Totally 4600 children were screened between November 2005 and May 2007 in the nearby schools of Chennai city. Out of these 4600 children, 96 children were found to have asymptomatic heart murmur.Among these 96 children, 42 children had cardiac lesion, remaining 54 children had innocent murmur without any organic cardiac lesion.



PREVALENCE OF CARDIAC DISORDERS IN ASYMPTOMATIC CHILDREN

Total number of school children examined		-	4600
Clinically asymptomatic heart murmurs		-	96
Heart disease diagnosed by echo cardiogram		-	42
Ventricular septal defect -Mild		-	11
	Moderate	-	3
	Large	-	NIL
Mitral valve prolapse		-	8
Atrial septal defect	- mild	-	4
	- moderate	-	1
	- large	-	NIL
Mitral valve prolapse with mild mitral regurgitation		-	4
Patent ductus arteriosus	- small	-	3
	- moderate	-	NIL
	- large	-	NIL
Mild pulmonary stenosis		-	3
Bicuspid aortic valve		-	2
Rheumatic heart disease – mitral regurgitation		-	2
Cardiomyopathy (HOCM)		-	1
Normal study		-	54

PREVELANCE RATE OF HEART DISEASE IN ASYMPTOMATIC CHILDREN WITH CARDIAC MURMURS.

From the obtained data, the various prevalence rates were calculated as below,

1. Prevalence rate of asymptomatic heart murmurs- 20.8/1000 children

2. Prevalence rate of innocent murmurs without any organic cardiac lesion - 11.7/1000 children

3. Prevalence rate of organic murmurs with cardiac lesion - 9.1/1000 children

In this present study, children screened belong to the age group between 5-15 years which is represented as follows (table 1)

AGE DISTRIBUTION OF CHILDREN SCREENED

TABLE I

Age in years	Male	Female	Total
5 years	200	198	398
6 years	190	204	394
7 years	165	170	335
8 years	190	184	374
9 years	180	190	370
10 years	144	154	298
11 years	180	177	357
12 years	208	215	423
13 years	264	271	535
14 years	254	250	504
15 years	300	312	612
TOTAL	2275	2325	4600

AGE DISTRIBUTION OF ASYMPTOMATIC CHILDREN WITH CARDIAC

DISORDERS

TABLE II

Age group	No. of children screened	No. of children with heart disease	Age-specific prevalence (%)
5-8 years	1501	22	1.46%
9-12 years	1448	14	0.96%
13-15 years	1651	6	0.36%

The prevalence rate of cardiac disorders in various age groups

5-8 years - 1.46%

9-12 years - 0.96%

13-15 years - 0.36%

The prevalence of cardiac disorder was higher in the 5-8 years age group than that of other ages.(table II)

GENDER DISTRIBUTION OF ASYMPTOMATIC CHILDREN WITH CARDIAC DISORDERS

TABLE III

Gender	No. of children screened	No. of children with heart disease	Prevalence of cardiac disorders (%)	P value*
Male	2275	22	0.47%	0.70
Female	2325	20	0.43%	

(*: Chi square test)

From the above table there is no significant difference in the prevalence of cardiac disorders in children according to gender, since the calculated P value was >0.05 (P: 0.70).

DISTRIBUTION OF VARIOUS CARDIAC LESIONS AMONG STUDY POPULATION

TABLE IV

Cardiac lesions	**Male**	**Female**	**Total**	**Prevalence**
VSD	8	6	14	0.30%
MVP	2	6	8	0.17%
ASD	3	2	5	0.10%
MVP with mild MR	1	3	4	0.08%
PDA	1	2	3	0.06%
Mild PS	2	1	3	0.06%
Bicuspid Aortic Valve	2	0	2	0.04%
Rheumatic MR	2	0	2	0.04%
HOCM	1	0	1	0.02%

Totally 42 children had organic cardiac lesion. Ventricular septal defect (VSD) was the most common heart disease observed (0.30%). Second most common cardiac disease observed was mitral valve prolapse (MVP: 0.17%). Two children of the study population were diagnosed to have mitral regurgitation who were investigated for rheumatic activity which was found to be positive. Both of them were started with suppressive therapy followed by prophylactic treatment for rheumatic fever. Least common cardiac lesion observed was hypertrophic cardiomyopathy. (table III)

All the 96 children with heart murmurs observed were subjected to undergo

X ray chest, Electrocardiogram, and Echocardiogram.

All the 96 children had normal chest X ray, ECG findings, except one asymptomatic child with HOCM had cardiomegaly by X ray chest, and chamber enlargement in ECG.

By Echocardiography, out of these 96 children with asymptomatic heart murmurs, 42 children were diagnosed to have organic heart disease, remaining 54 children had no organic heart disease.

So the diagnostic utility of X ray chest and ECG for asymptomatic heart disease during the earlier stage was lower than the echocardiography.

All these 42 children with heart disease were registered in cardiology outpatient department. They were given appropriate treatment (like antimicrobial prophylaxis against bacterial endocarditis during times of risk, surgical advice, reassurance) as advised by pediatric cardiologist and they were followed up further.

DISCUSSION

The prevalence of cardiac disorders in asymptomatic school children between 5-15 years of age was 9.1 per 1000 in the present study.

Rana olgunturk et al[17] who have conducted the study in school children between the ages 6-17 years in Turkey 2001. He had observed the prevalence of cardiac disorders in asymptomatic school going children was 5/1000.

Tay et al[21] who had observed prevalence among school children between 5-15 years was 3/1000.

Meclaren and Lachman et al[22] have studied the prevalence rate of heart disease in school children aged 2 to 18 years was 4/1000 children in Brittan.

Study by Danford et al[23] in Brazil has shown that the prevalence rate of heart disease was 6/1000 children.

Most of the western studies[17,21-23] done previously showed lower prevalence (3-6/1000 children) of heart disease in asymptomatic school children compared to the Indian studies. In this present study the calculated prevalence was quite higher (9.1/1000 children).

Study by Tay et al[21] showed that boys were affected more than girls but not statistically significant.

Study conducted by Degroff et al[24] showed that the prevalence of heart disease was equal in both sexes.

Study by Danford et al[23] have shown that the prevalence of heart disease was

equal in both sexes.

This present study also showed that there is no significant difference in the prevalence of heart disease in asymptomatic children according to gender.

Study by Danford et al[23] showed that X ray chest and ECG were found to be of no help in discrimination between heart disease and no heart disease but suggest to perform Echo for complete assessment.

Study by Manes et al[19] showed that Echocardiographic examination in children with asymptomatic heart murmur was useful to identify the underlying organic heart disease.

Study by Birkeback et al[20] showed that CXR and ECG were of no help in discrimination between heart disease and no heart disease in asymptomatic children with heart murmur.

In the present study also there is no significant abnormality in chest X ray and ECG among 42 children with organic heart disease, since all of them were asymptomatic and were screened during earlier period.

Most of the children with innocent murmurs and children with organic murmurs are asymptomatic during the initial period. They don't show any significant abnormality in X ray chest and ECG during the initial period even though they had any organic heart disease. But they can be identified accurately by Echocardiography.

So it is not necessary to perform ECG and chest X ray routinely for all children with asymptomatic heart murmurs rather than doing Echocardiography.

Study by K.Y.Chan and U.Rajan et al[18] showed that Mitral valve prolapse (0.08%) was the most common heart disease in asymptomatic school children.

Denvizmen Aygun et al[26] who had observed Ventricular septal defect (0.08%) was the most common cardiac lesion in school children.

Study by Rana Olgunturk et al 17 showed that Ventricular septal defect (0.09%) was the most common cardiac lesion in school children.

This study also showed that Ventricular septal defect (0.3%) was the most common heart disease in asymptomatic school children.

SUMMARY

1. The Prevalence of asymptomatic heart murmur in school children between 5-15 years of age was 20.8/1000.

2. The Prevalence of innocent murmurs without any organic cardiac lesion in school children was 11.7/1000.

3. The Prevalence of organic murmurs with cardiac lesion in asymptomatic school children was 9.1/1000.

4. The Prevalence of cardiac disorder was higher in 5-8 years age group than that of other ages.

5. The Prevalence of cardiac disorder was equal in both sexes.

6. The chest Radiography and Electrocardiography were of no help in discrimination between heart disease and no heart disease in asymptomatic children with heart murmur.

7. The gold standard for the diagnosis of a structural cardiac disease is an Echocardiographic Evaluation.

8. Ventricular septal defect was the commonest heart disease in asymptomatic school children with heart murmur.

CONCLUSION

Even though children with heart murmur may be asymptomatic, they may have significant underlying organic heart diseases. So it is mandatory to screen for the cardiac ailment during school health check up to identify the underlying asymptomatic organic heart diseases during the initial period, for prevention of its complications.

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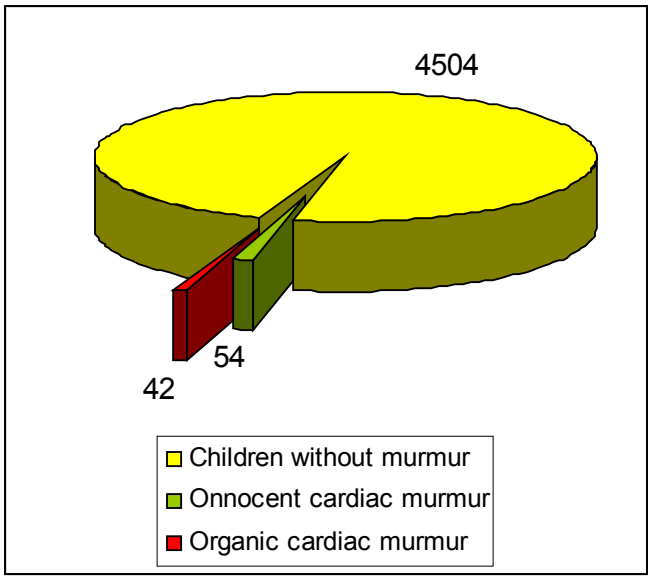
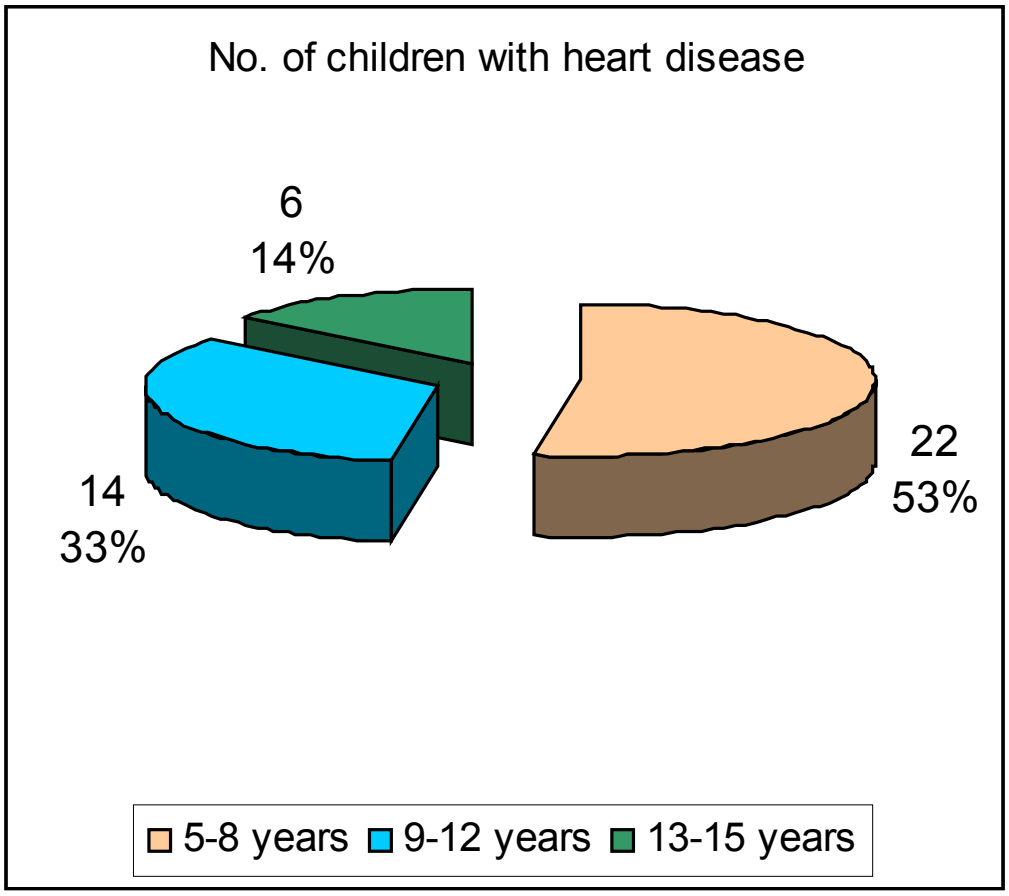
ABBREVIATIONS USED IN THIS STUDY

1. CXR	-	chest x ray
2. ECG	-	Electrocardiography
3. ECHO	-	Echocardiogram
4. CDE	-	Colour Doppler Echocardiogram
5. VSD	-	Ventricular septal defect
6. MVP	-	Mitral valve prolapse
7. MR	-	Mitral regurgitation
8. ASD	-	Atrial septal defect
9. PDA	-	Patent ductus arteriosus
10. PS	-	Pulmonary stenosis
11.HOCM	-	Hypertrophic Obstructive Cardiomyopathy

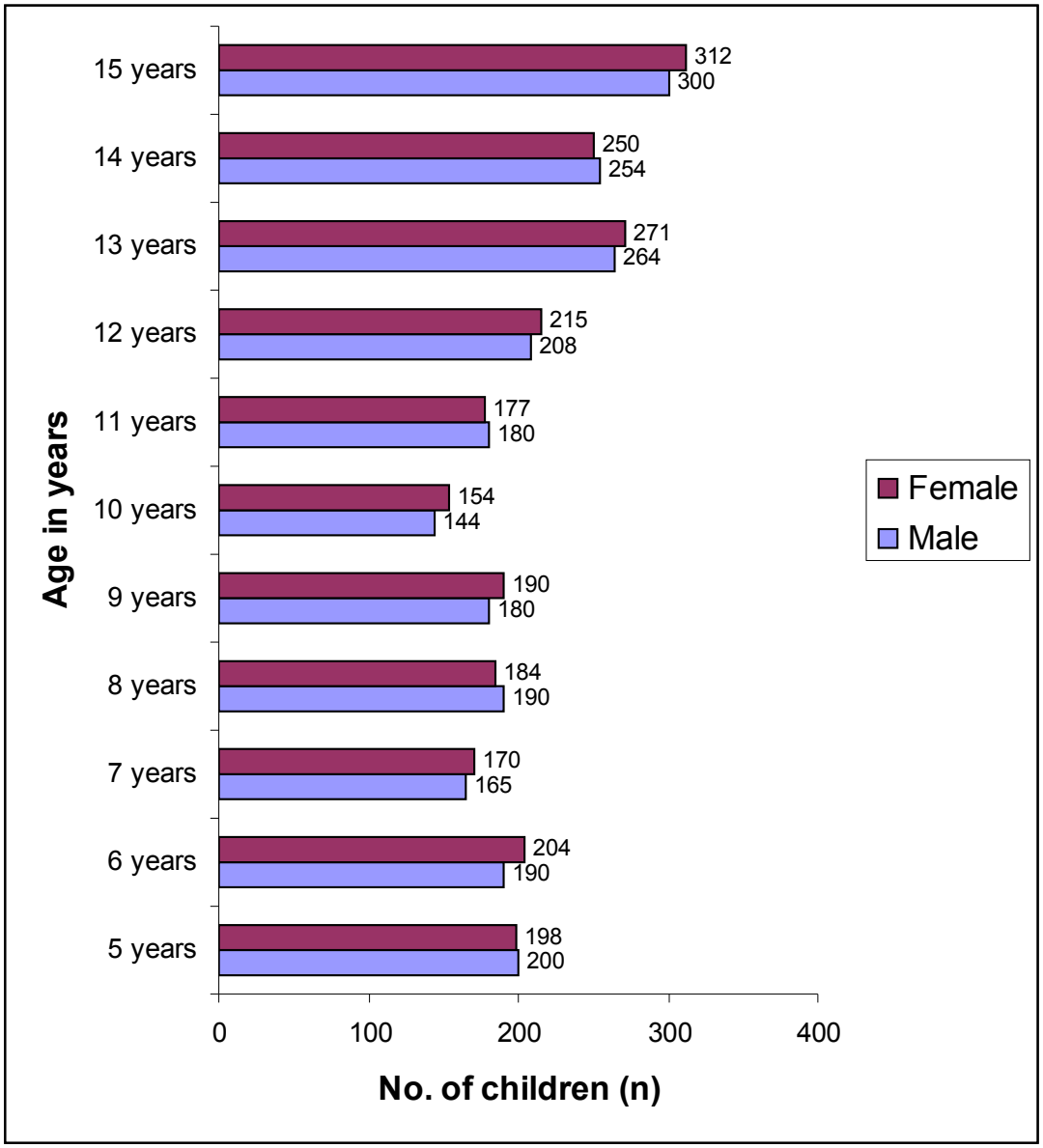
DISTRIBUTION OF CARDIAC MURMUR IN STUDY POPULATION



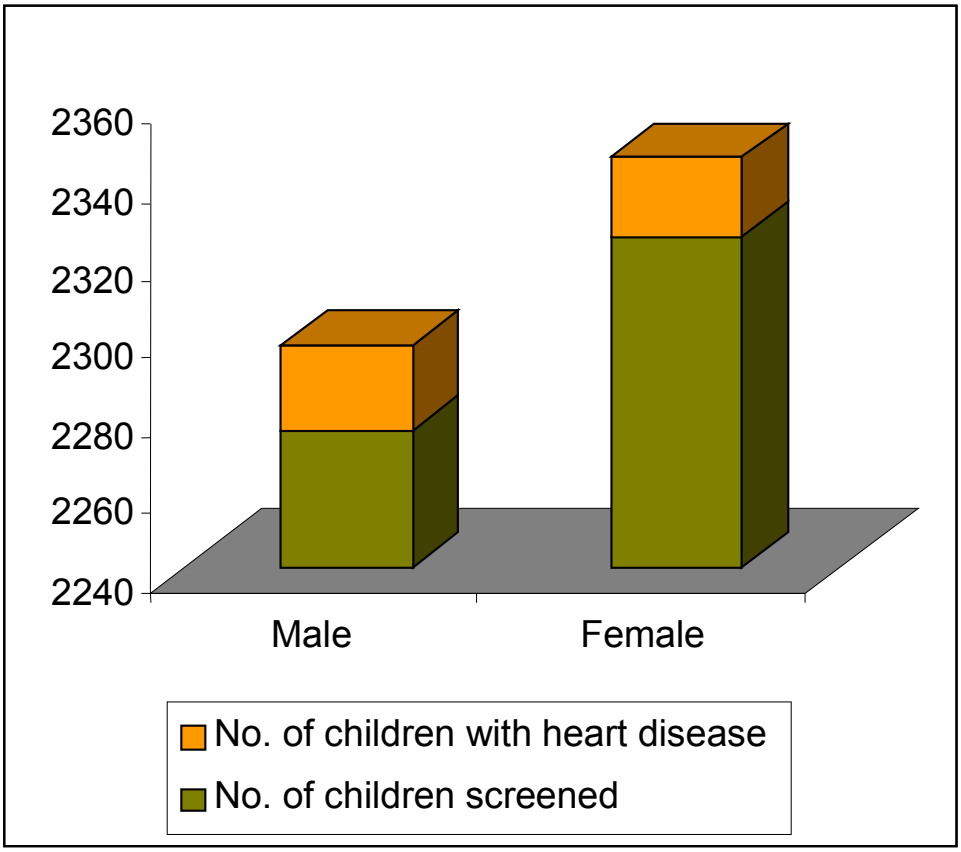
AGE DISTRIBUTION OF ASYMPTOMATIC CHILDREN WITH CARDIAC DISORDERS



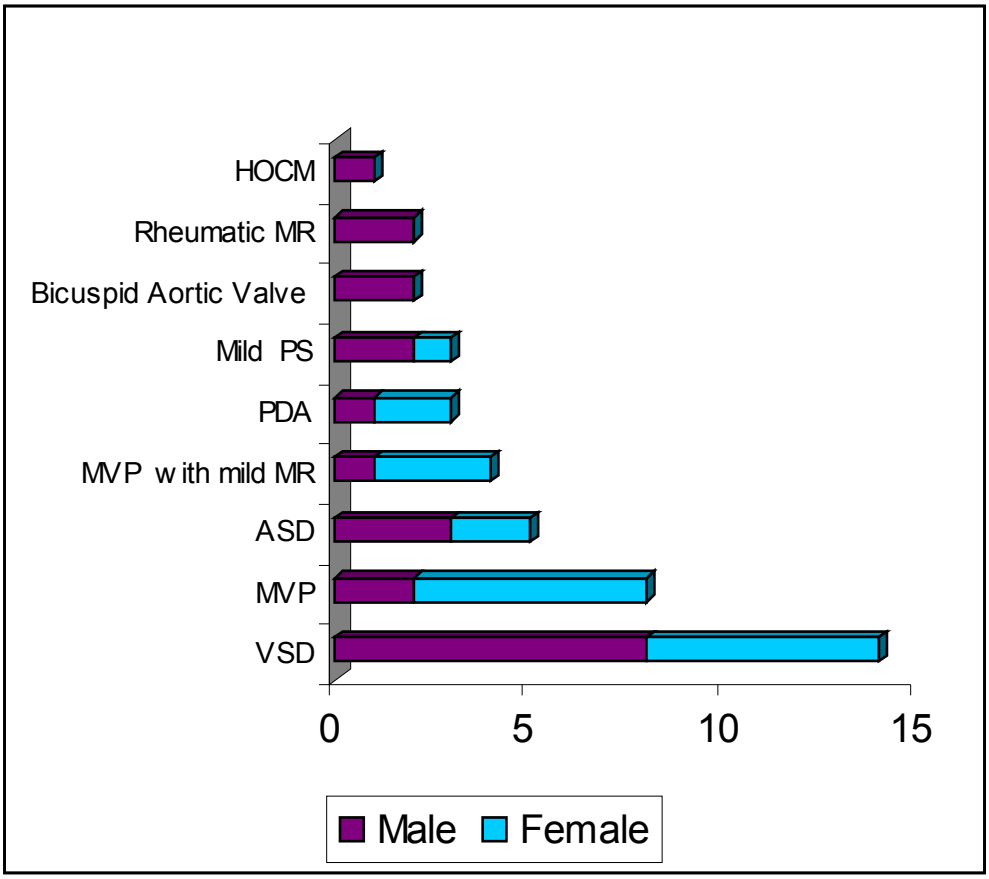
AGE DISTRIBUTION OF CHILDREN SCREENED



GENDER DISTRIBUTION OF ASYMPTOMATIC CHILDREN WITH CARDIAC DISORDERS



DISTRIBUTION OF VARIOUS CARDIAC LESIONS AMONG STUDY POPULATION



ANNEXURE

PROFOMA

Name Age Sex OP. No.

School

Address

History

Past H/o

General Examination

Examination of CVS

Inspection

Palpation

Percussion

Auscultation

Investigations

1) X ray chest – AP view

- Cardiomegaly
- C. T. Ratio
- Prominent Pulmonary Artery
- Chamber enlargement

2) Echocardiographic features

Rate

Rhythm

Axis

P. R. Interval

Chamber Hypertrophy

Heart block

Arrhythmias

3) Echocardiographic findings

Size of defect

Pressure in chamber of heart

Associated defects

Vegetations